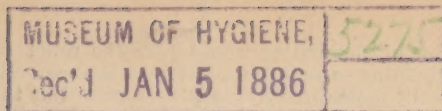


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REVIEW OF PLANS FOR THE SEWERAGE OF WASHINGTON.

*To the Honorable the Committee of the Senate
on the District of Columbia:*

GENTLEMEN: The attention of your honorable body is respectfully invited to the Review, hereunto appended, of plans presented to Congress for the improvement of sewerage and the sanitary condition of the City of Washington.

The failure thus far—*notwithstanding the millions spent*—to successfully drain this city gives more than ordinary interest to the matter under consideration, and establishes *the necessity* for the closest investigation as to *the merits* of the plans presented.

PLAN OF THE COMMISSIONERS OF THE DISTRICT OF COLUMBIA.

The plan presented by the Commissioners of the District of Columbia does not meet the requirements. The intercepting sewer which the Commissioners propose in New York avenue to run down Fifteenth street and across the White Lot to the Potomac, at Seventeenth street, presents numerous causes for objection, to wit: It would give but a small fraction of the relief needed. It would not prevent overflows upon the line of B street; it would give no security to cellars upon Pennsylvania avenue, Louisiana avenue, Market Space, Missouri avenue, &c. Its location is too high up; it is near the top of the hill; therefore it would intercept but little water. It could not be constructed east of Seventh street owing to the change of the grade of New York avenue at that point. It would empty against the current of the Potomac, and it would discharge the sewage at a point to which there are well-founded objections on sanitary grounds. Intercepting sewers, to render appreciable service, must be constructed at the lowest points at which the requisite fall can be had. The estimate which the Commissioners give for the construction of the proposed badly-planned sewer is \$65,867.70.

The intercepting sewer to the Eastern Branch, also proposed by the Commissioners of the District of Columbia, is a badly-conceived enterprise. The location specified is Boundary street, from Eighth street west to the Eastern Branch. About four years ago a sewer was built substantially upon the same line. It was constructed under the supervision of the gentleman who prepared the plan for this additional sewer to the Eastern Branch. The sewer built about four years ago cost over \$300,000. This is a great amount of money, but the constructors of the sewer told Congress and the public that *it would be a great triumph!* Now these same parties confess that the sewer built at an expense of over \$300,000 is *inadequate for the performance of the service required of it*. As a remedy for the failure they propose another sewer to the Eastern Branch. For this additional sewer the Commissioners of the District of Columbia submit to Congress the *very modest* estimate of \$435,696.47! This estimate is given "*approximately*," which uniformly means lower figures than the actual cost in such cases. The excessive excavations necessary on the line to the Eastern Branch (50 feet) greatly add to the expense. The extension of facilities for drainage in the Tiber Valley—

where a fraction of the outlay would give the relief needed—is vastly preferable to building sewers to the Eastern Branch. By way of James Creek canal is the most direct, it is the shortest line to the lowest spot on the Potomac—namely, the Arsenal Point, where the waters of the Potomac and those of the Eastern Branch meet. James Creek canal is a mile and a quarter in length, and is of more than ample capacity to carry off all the drainage of the Tiber Valley. This mile and a quarter of canal, over sixty feet wide, would save the construction of a mile and a quarter of a large culvert—about a half million of dollars! It is a sanitary measure of the first importance to carry the waters of the Tiber Valley by way of James Creek canal; they are specially needed to flush that canal, a duct by which the sewage of a large and densely populated portion of the city is carried off. Indeed James Creek is the proper outlet for the sewage of the *entire city*; therefore the waters of the Tiber should be concentrated upon the outlet of the sewage. Every pint of water carried to the Eastern Branch, therefore, is a loss. Is it not a contradiction to be devising and considering plans for flushing the B-street sewer, the Missouri-avenue sewer, and the James Creek canal, by the employment of steam power and other devices at enormous expense, and at the same time to contemplate spending a *half million of dollars* for the purpose of carrying nature's great sanitary agent—*pure water*—out of the city to the Eastern Branch by intercepting sewers?

PLAN OF MR. RICHARD RANDOLPH.

Mr. RANDOLPH's plan makes no provision for drainage or for the emergency of the hour, the combating of the tides and the freshets, as will be seen by the following extract from it. Mr. Randolph says:

"This plan simply insures to the tide-locked sewerage from B street to Pennsylvania avenue a constant flushing with a large quantity of pure water forced from the Potomac, and the discharging of the same, together with the sewage, into the channel at the mouth of the Eastern Branch, being the extreme southern limit of the city."

Of the power required to work the machinery which Mr. Randolph proposes constructing in the mouth of the B-street sewer, at Seventeenth street, he says:

"*This apparatus is to be worked by a steam engine with double boilers and cylinders of one hundred horse power.*"

Of the machinery which Mr. Randolph proposes erecting on the B-street sewer, at Tenth street, he says:

"In the neighborhood of Tenth street is located another apparatus similar to the former, except that the wheel is five feet in diameter instead of twelve, as there is no storm water to be passed in that direction. It is connected with the main sewer by a short conduit which admits its contents through an opening lower than the wheel, which is just below low tide, so that when it is in operation the contents of the main sewer can be lowered to that level, being shut off from the river by a gate at the outlet. This wheel propels always in the same direction, and maintains the water within its enclosure at an elevation of seven feet above that in the sewer. *This enclosure is connected with the Tiber Creek culvert by a conduit of five feet in diameter, to be constructed on the most direct line through the Government reservation between Sixth and Seventh streets, and along Missouri avenue and Third street. This conduit receives the fluids from the enclosure just above the wheel which elevates them from the sewer, and which maintains a head sufficient to cause a discharge into Tiber Creek.*"

"The apparatus at Seventeenth street will work periodically, lifting the pure water of the Potomac and filling the system of depressed sewers as full as can be done without flooding the cellars, when the gate will retain them until the wheel at Tenth street shall have forced the sewage, thus largely diluted, into the Tiber; when they are again filled to be again emptied."

Italics by the reviewer. The above abounds in complications. The plan is difficult to explain; it is even more difficult to understand; and it is still more difficult to appreciate by those who own property—*cellars in particular*—upon the line of Pennsylvania avenue, Market Space, Louisiana avenue, Missouri avenue, &c. All considered, while the expense would be enormous, Mr. Randolph presents a very questionable means for flushing the B-street sewer. The construction of two hundred horse power, and the working of it day and night, presents an *expense fearful to contemplate*. Besides the machinery, there would be *two engine-houses* required—one at Tenth street, and another at Seventeenth street;

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in order to be suitable for the extensive power which Mr. Randolph proposes constructing, *superb buildings* would be required. Besides the buildings, the boilers, and the engines, Mr. Randolph says it would be necessary to construct a *large sewer* from the Tenth-street engine-house "to *Tiber Creek culvert*," where he proposes delivering the liquids which would be *twice raised* by machinery—*once* at Seventeenth street and *once* at Tenth street. Notwithstanding that the liquids would be *twice raised* by steam power, they would, Mr. Randolph says, be delivered in Tiber culvert at a point *two miles from the Potomac*! What, then, would be accomplished by the engine-houses, the boilers, the engines, the machinery, and the large sewer? The engine-houses would be in the way; they would be impediments and public eyesores. The fuel necessary to work the *two hundred horse power* is here given in accordance with the formula. $3\frac{1}{2}$ pounds of coal—best quality—for each horse power per hour, being the recognized standard; but no allowance is here made for probable short weight, loss by cartage, &c.; therefore the amount generally consumed is *in excess* of that given in the formula. For two hundred horse power it will be seen that, in accordance with the formula, 16,800 pounds of coal would be required for twenty-four hours, equivalent to $7\frac{1}{2}$ tons. This, at present market prices—\$3.75 per ton—would be \$28.12 $\frac{1}{2}$ per twenty-four hours; \$10,265.62 $\frac{1}{2}$ per annum. Besides, consider the wages of the corps required to work *two large engines*. Each engine would require an engineer, a fireman, a coal-heaver, a "general utility man," and a superintendent. The pay of the corps may be given thus: Engineer, \$3 per day; fireman, \$2 per day; coal-heaver, \$1.50 per day; "general utility man," \$2 per day; superintendent, \$4 per day. This makes \$12.50 per day for a single corps. Each engine would require *three corps*; at such hard work and responsible labor men could not perform their duties properly and *work twelve hours per day*; therefore to have *three corps* would be indispensable. These, for *one engine*, would be \$37.50 for each twenty-four hours; for the two engines, \$75 for each twenty-four hours; \$27,375 per annum; and when the price of fuel is added, it will be seen that the expense of labor and fuel foot up \$37,640.62 $\frac{1}{2}$ per annum, without mentioning the expense of constructing engine-houses, boilers, engines, special sewer, wear and tear of machinery, oil, &c.

Consider *the great expense*; compare it with *the little* which would be accomplished by the adoption of Mr. Randolph's stupendous plan! Reflect upon the *stirring up* of intolerable odors, day and night, in the heart of the city with two hundred horse power. And what would be accomplished by this marvelous expense and the nuisance which it would create? *Nothing of value*! Mr. Randolph tells Congress and the public that he would deliver the filth of the B-street sewer "*in Tiber Creek culvert*," *the place from which a great portion of the city is inundated by the waters of the Tiber backing up in the Missouri-avenue sewer*! Consider the waters of the Tiber *forcing back the filth to the very point or points from which Mr. Randolph had removed it with his two hundred horse power*! Nay, more; the waters of the Tiber, backing up as they do, would force the pernicious filth spoken of into the stores and residences of the lower portion of the city. Besides, reflect upon the probable *flooding of cellars* on Pennsylvania avenue, Louisiana avenue, Market Space, Missouri avenue, &c., with the great charges of water which Mr. Randolph would pump from the Potomac into the B-street sewer.

Special attention is invited to the following extract from Mr. Randolph's explanation of the workings of his method:

"When this wheel revolves by steam power in one direction, *the water is elevated within the enclosure, and, consequently, throughout the depressed sewers with which it is connected*. When it revolves in the other direction, the water is forced downward, and the discharge from the sewer is accelerated. If there is no power applied to the wheel by the steam engine, *it will revolve by the natural flow of the water outward*; but, having no resistance, and being of ample size, *the discharging capacity of the sewer will be the same as that which it has at present*."

Italics by the reviewer. Note *the elevation of the water in the depressed sewers*. Is not this the evil during freshets? Is it not the eleva-

tion of the water in the depressed sewers that produces overflows in cellars? Is water raised by machinery less hurtful than overflows produced by freshets?

In the absence of steam, consider the impediment which an apparatus requiring an hundred horse power to propel it would put to the already feeble flow in the B-street sewer! Yet the reader is told that in the event of steam power not being applied to the wheel, "the discharging capacity of the sewer *will be the same* as that which it has at present." These statements of Mr. Randolph are not sustained.

It will be seen that Mr. Randolph's method would continue the discharge of the drainage of the B-street sewer westward, notwithstanding that the Potomac is from eight to ten feet higher at Seventeenth street than at James Creek in times of great freshets. The excessive height of the Potomac west of the Long Bridge during freshets is caused by the impediment which the causeway of the bridge puts to the flow of the river, and by the excessive grade which the waters form when traveling from eight to ten miles per hour. Fully ten feet fall is lost by discharging the water of the sewers in the western section of the city during freshets; besides, a powerful current is encountered. The flow in all the sewers should be turned eastward. This would promote fall, and it would also be a great sanitary measure.

It will be seen that the entire line of sewers from Seventeenth street to James Creek can be thoroughly flushed by the following plan without the aid of steam or machinery, and without *any expense* after the pipe shall have been laid:

"Connect the B-street sewer with the Missouri-avenue sewer, and extend the Missouri-avenue sewer down Third street to Virginia avenue, and extend it in Virginia avenue to James Creek canal, the sewer to be entirely disconnected with the Tiber Creek sewer. All the drainage would be turned eastward. Put a self-acting gate on the mouth of the sewer at the canal; this would keep out tides and freshets. Lay a line of iron pipe, three feet in diameter, from the dam in Rock Creek, at Twenty-seventh and H streets, to the B-street sewer; the distance is only ten squares, and the line of the old canal affords facilities for laying the pipe, being uniform and easy of excavation. The pipe to be secured in the sewer with mason-work and cement. This would keep out tides and freshets. The dam is six feet above low-water in the Potomac, affording ample pressure. By means of a stop-cock, water could be turned on at low tide, and the entire line of sewers from Seventeenth street to James Creek could be flushed. This would be a great sanitary work. This plan is inexpensive, and would work well."

This is a part of my plan published in Senate Mis. Doc. No. 19, page 22, 45th Congress, 3d Session.

Mr. Randolph recommends the carrying of the sewage of Georgetown into Washington! Describing a sewer from Georgetown to this city, the construction of which he recommends, he says:

"This, then, will be the main sewer of both cities, and should be of ample dimensions to receive also the surface drainage which cannot be elsewhere discharged. Its location is apparent. It must follow the present margin of the river until after curving around Observatory Hill, and thence along the line of B street."

Italics by the reviewer. Mr. Randolph here presents an elephant of alarming proportions. *The line of B-street is where lies the great, the only difficulty in the way of controlling and perfecting the sewerage of Washington. Shall the embarrassments of the B-street basin be increased by forcing the sewage of Georgetown upon it? The drainage of the Canal Valley involves the entire problem of the sewerage and drainage of Washington. Shall the sewage of Georgetown, a city which has facilities for drainage unsurpassed by those of any city in the world, be carried into the depressed Canal Valley?*

Mr. Randolph suggests changing the line of the Tiber Creek sewer, as will be seen by the following extract. He says:

"The new culvert should be located upon a line running parallel with First street west and at a short distance east of it, connecting with the present stream, with a curve across New Jersey avenue, and extending through the Capitol grounds in a straight line to an intersection with Delaware avenue, near South E street."

Italics by the reviewer. The Tiber Creek sewer is in the channel which nature formed. There is not anything wrong about it, save that it is too small. Its bed is the lowest level; why raise it to a higher level?

Is the incurring of *unnecessary expense* an amusement in which to indulge? *Shall the grounds of the Capitol be broken up and a large culvert be built in their midst?* The suggested change of the line of Tiber Creek sewer seems to be as badly considered as the suggestion to plant trees in Virginia as a means of beautifying the city of Washington. This Mr. Randolph recommends. He says:

"If more parks and trees are needed for this city of parks, let them be planted upon the Virginia shore, where distance will lend enchantment."

The only trouble about the waters of the Tiber is that man has put impediments to their flow by unwisely denying that powerful current the space which it requires, and which, in accordance with the laws of nature, it insists upon having; hence the overflows.

PLAN OF MR. HENRY F. KNAPP.

Mr. HENRY F. KNAPP presents a plan for flushing the several sewers of the city with water from the regular supply service. He appears to be well posted in sanitary engineering.

PLAN OF MR. A. C. FOWLER.

Mr. A. C. FOWLER presents a well-written description of the topography of the city of Washington and the location and volume of its several basins. He presents a plan for the construction of separate sewers for the house-sewage. This would not work well. The storm water is the only agent now available for flushing the sewers and the sewage.

PLAN OF MR. B. SEVERSON.

Mr. B. SEVERSON presents a plan for the relief of the Canal Valley and the Tiber basin. He pronounces the B-street and Missouri-avenue sewers deficient in capacity. He says:

"Therefore, these will have to be abandoned *too* a proper substitute shall have been provided for them, as now proposed. This, too, will probably require a *span of thirty feet and a rise of ten feet*. It should be placed along the south side of the B-street and Missouri-avenue sewers, *connected with the Tiber at Third street*, and extended westward to the basin west of Sixteenth street. The size named for this part *is larger than is required* for the liquids flowing in from its own contributing branches; but the excess in its capacity will serve to *relieve the Tiber sewer* whenever that may become surged with flood-water, by letting a portion of it *flow westward* through this large sewer."

Italics by the reviewer. Mr. Severson errs. It is wrong to connect the sewer of the Canal Valley with the Tiber culvert. The sewer which he proposes is excessive, regardless of the expense of construction, and he is sorely in error in suggesting a culvert on the line of Missouri avenue and B street as an outlet for the waters of the Tiber in the western part of the city, against the current of the Potomac, and at a great loss of fall, the Potomac being from eight to ten feet higher at Seventeenth street than at James Creek in times of great floods, the only periods when the waters of the Tiber require extra outlets. James Creek canal affords the best outlet for the waters of the Tiber basin; it is the *natural* outlet of the Tiber Valley. It may be added that property in the Canal Valley suffers too much from floods without *inviting* the waters of the Tiber to add to the mischief. Besides, consider the cost of constructing *two miles* of culvert of thirty feet span and ten feet rise, when a little more than a *half mile* of sewer will carry the waters of the Tiber from the Botanical Garden to James Creek canal, which has ample capacity to carry them to the Potomac, with the advantage of the fall which would be lost by carrying the waters westward.

PLAN OF W. D. HUGHES.

The problem of the sewerage of Washington is to properly provide for the drainage of the B-street basin and the Tiber basin.

To accomplish this successfully, it is necessary to sever *all* communication between the waters of the respective basins.

There is a powerful fall in the Tiber Valley while the Canal Valley is flat, substantially level; therefore a *union* of the waters of these basins is prejudicial to property in the Canal Valley. This is established by

the constant backing up of the waters of the Tiber in the Missouri-avenue sewer, which is connected with the Tiber culvert at the Botanical Garden. The water which thus backs up inundates the business property on Pennsylvania avenue and the residences on Missouri avenue with the filth of the sewers, alike hurtful to health and injurious to property. The effort to unite the waters of the B-street basin and the Tiber basin *in one culvert* is a fatal error; hence the necessity for separating them. Great damage is also done to health and property by the influx of the waters of the Potomac in the B-street sewer during freshets. By this influx the great business center of the city—Pennsylvania avenue, Louisiana avenue, Market Space, and the numerous streets bordering upon these thoroughfares—is inundated with fecal matter which the strong pressure of the incoming waters force from the B-street sewer and its numerous tributaries, damaging large quantities of merchandise.

Remedies are needed. Turn the drainage of the entire city eastward: *this is nature's* course for the waters; it will give fall and sanitary advantages; it will carry the sewage *from the city, not into the city*—as is being done by the B-street sewer discharging westward. Cut off *all* communication between the B-street sewer and the Potomac on the west, and sever *all* communication between the waters of the B-street basin and those of the Tiber valley. Provide intercepting sewers *for every drop of water* of the B-street basin that it is possible to deliver into the Potomac above tide. By this the flow in the Canal Valley can be diminished three-fourths. Construct a basin at the Arsenal Point, the extreme southern limit of the city, and discharge the water from it into the Potomac by pumps. The point named is where the waters of the Potomac and the Eastern Branch meet. The meeting of the waters will *annihilate the sewage*. The volume of the drainage having been greatly diminished by intercepting sewers, *seventy-five horse power* will be sufficient to discharge the sewage from the basin into the Potomac, and *sixty per cent. of this power can be had from the flow of the sewers!* (See my original plan published in Senate Mis. Doc. No. 19, pages 19, 20, 21, 22, and 23, 45th Congress, 3d Session.) Therefore the expense for steam-power would be small. Put a sluice upon the mouth of the B-street sewer at Seventeenth street. This will keep out tides and freshets and admit *only sufficient water to flush* the line of sewers. The basin being kept some feet lower than the Potomac, the flow in the sewers from Seventeenth street to the basin *would be active*; and, being constantly flushed by the water of the Potomac running through the sewers by gravity, their sanitary condition would be perfect.

This is better than *filling all the low* sections of the city, while the cost would be insignificant compared with the expense of filling. *It is more sanitary* than filling. Deeper drains than are now available can be constructed; therefore the soil *can be perfectly drained*. Cellars on Pennsylvania avenue, Louisiana avenue, Market Space, Missouri avenue, and upon the numerous streets connecting with these principal thoroughfares *can be made perfectly dry!* Flood-valves would not longer be needed, and tides and freshets would be controlled. To fill would be to destroy a story of every building on Pennsylvania avenue, Louisiana avenue, Market Space, Missouri avenue, and the several streets which cross those avenues; to change the grades; to cause heavy assessments for damages to property; to destroy the beauty of this Capital for years while the work would be in process; to impede the business of the city; and, perhaps, to subject the city to a plague by the upturning of filthy soil, the raising of buildings, &c. And then consider the cost! Yet *the best authorities* on sanitary engineering are *unanimous* in the opinion that there are *only two ways* in which the difficulty can be overcome, to wit, *pumping or filling*. It is not possible to lower the Potomac, but it is possible to construct a basin the water in which could be kept below the level of the Potomac by the use of pumps; *this would be equivalent to lowering the Potomac!*

The Tiber basin is not included in the section needing pumping. The

waters of the Tiber are sufficiently powerful to force their way into the Potomac through James Creek canal, and, in doing so, *they flush the canal*. The waters of the B-street and Missouri-avenue sewers would be carried to the basin by a sewer down Third street. In any event, the waters of the Canal Valley must be separated from the drainage of the Tiber basin. Should the plan for pumping not be executed, the necessity for constructing the intercepting sewers and for turning the drainage eastward remains unchanged. In that event, the B-street and Missouri-avenue sewers can be thoroughly flushed at low tide by the waters of Rock Creek, as provided for in my plan for flushing, published in Senate Mis. Doc. No. 19, page 22, 45th Congress, 3d Session.

Intercepting sewers may be constructed to special advantage on the lines hereinafter described. While intercepting about three-fourths of the water which runs in the Canal Valley, they would deliver into the Potomac above tide.

A sewer from the corner of Fifteenth and G streets northwest, in G to Fifth street, across Judiciary Square to Fourth and E streets, in E to Third street, in Third street to Virginia avenue, and in Virginia avenue to James Creek canal. Even more water can be intercepted as follows: A sewer from the corner of Fifteenth and G streets northwest, in G to Ninth street, and on the line of Ninth street to the Potomac, *crossing over the B-street sewer*; and a sewer beginning in Louisiana avenue, opposite the City Hall, thence down D street to Ninth street, where it would join the sewer already mentioned and deliver in the Potomac above tide. These waters can be carried *over the B-street sewer* without difficulty. By these sewers *all the water* north of D and G streets, from the City Hall to the Treasury, can be intercepted and delivered in the Potomac *above tide*. In South Washington a sewer can be constructed about one hundred yards south of the B-street sewer which would intercept *all the water* running north and northeast in that section of the city. Its course would be southeasterly to the Potomac, where it would deliver above tide.

Plans in detail of these sewers may be found in Senate Mis. Doc. No. 19, page 22, 45th Congress, 3d Session.

S. T. ABERT, Colonel of Engineers, U. S. A., who is excellent authority on the matter under consideration, says:

"The most efficient method would probably be to provide intercepting sewers for *all higher levels* to discharge into the river by gravity, and for the lower districts to be provided with special sewers and with pumping stations, near the river channel, which will raise and discharge the sewage at such levels as the stage of the water may require."

HENRY F. KNAPP, Esq., of New York, an expert in sanitary engineering, says:

"Washington sewerage seems to be defective by reason of sluggish flow, formation and escape of sewer gas, the reflux of incoming tides, together with a partial filling or damming up by deposits by reason of an insufficient and intermittent flow of water through them, thereby still further decreasing the velocity of an already sluggish flow, and retaining the sewerage sufficiently long to decompose and resolve itself into a gaseous state, in which condition it is almost invariably forced to escape out of the sewers through manholes and culverts of basins *by incoming tides*; and such escape *without doubt causes the great amount of malaria and sickness that pervades Washington*."

By pumping the sewerage of the lower levels *all communication of the tides with the sewers will be cut off, and the cause of sickness, so clearly and conclusively set forth by Mr. Knapp, will be permanently removed*.

A. C. FOWLER, Esq., a capable sanitary engineer, on the matter of pumping, says:

"This is quite feasible, and, on first study, will lead to the belief that it is the only method to be recognized. *It possesses the advantage of draining the subsoil more completely than any other that can be employed, since sewer drains can be laid at greater depth*. This is a point, as remarked, of much importance."

Having, on preceding pages, shown the damage to health and property which is caused by the *effort to unite the waters of the Tiber basin and those of the B-street basin in one culvert*, it may be well to endeavor to explain the impediment which is put to the flow of the waters of the

respective basins by conveying them from the Botanical Garden to James Creek canal in *one duct*. This explanation includes the cause of the bursting of the culvert in the Botanical Garden in August last. The Tiber culvert is about two miles in length, and, while it is smaller as it extends north, substantially the same body of water passes through it north of the Botanical Garden which passes through it in that garden. The question, therefore, presents itself, why the burst in the Botanical Garden, while the culvert remains in good condition north and south of that point? The answer is easy. The sewers meet at the Botanical Garden in the form of a V; after meeting the V is changed to a Y, by the continuance of the waters south. The meeting of the waters of the Tiber with the waters of the Canal Valley at the sharp angle which forms the V causes an *impediment* to their flow. This impediment causes an *accumulation of the waters*, and the accumulation is intensified by the pressure of the higher levels; hence the burst. The constructors of the sewers may have made correct calculations for the united measurements of the sewers, but they evidently failed to make proper allowance for the *accumulation* caused by the impediment which is put to the flow of the waters in the sewers by the junction.

Having described the cause of the bursting of the culvert in the Botanical Garden—and *what caused it once* is capable of causing indefinite repetitions of the calamity, and the more easily in future, as the repairs which may be made upon the culvert *will not* be capable of bearing as much pressure as the original work—the first duty is to provide means by which repetitions of the disaster may be averted. By cutting the Missouri-avenue sewer—a sewer of twenty-six square feet section—from the Tiber culvert, permanent relief may be had for the sewer which runs through the Botanical Garden. By disconnecting the Missouri-avenue sewer with the Tiber culvert, twenty-six square feet capacity will be added to the Tiber culvert. Had the culvert had these twenty-six square feet of relief in August last, *the burst in it could not have occurred*.

Here is presented a positive and an inexpensive means of relief for the culvert in the Botanical Garden; and, while relieving that culvert, it will also relieve the Missouri-avenue sewer, which will be carried to James Creek canal or to the Potomac separately. This will end the backing up of the waters of the Tiber in the Canal Valley, and will give the waters of the B-street basin the outlet they so much need. Should the plan for pumping be executed, the Missouri-avenue sewer will be carried to the Arsenal Point by way of Third street; should that plan not be executed, an outlet will be given to the waters of the B-street basin in James Creek canal.

The relief here given to the Tiber culvert *destroys* the claim of the advocates of a sewer to the Eastern Branch at an expense of \$500,000, and *removes the necessity for the "overflows"* recommended by the engineer of the District of Columbia as preventives of disasters in the Botanical Garden. Thus *nearly a half million of dollars will be saved*; besides, a better order of things generally would prevail, including the flushing of James Creek canal with the pure water which the proposed sewer to the Eastern Branch would carry out of the city.

The sewerage of Washington is a matter of three-fold consideration. It is important in a sanitary and in a commercial point of view, the business portion of the city being in the flooded district; and it is of special interest to taxpayers, who have to foot the bills, and who, too often, pay for intolerable botcheries in the form of sewerage and other city "improvements." The taxpayers cannot afford to pay for a continuance of the blunderings of the past, nor can the healthfulness of this Capital longer be imperiled; therefore, I furnish in this Review the text of the principal plans presented for the improvement of the sewerage of Washington and *bring to view the merits and the demerits of the respective plans, and show how millions can be saved*.

W. D. HUGHES.

WASHINGTON, D. C., January, 1879.